Trig-Tek™

530B
Tracking Filter
User Manual

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Astronics Test Systems Inc.
4 Goodyear, Irvine, CA 92618
Tel: (800) 722-2528, (949) 859-8999; Fax: (949) 859-7139

atsinfo@astronics.com atssales@astronics.com
atshelpdesk@astronics.com http://www.astronicstestsystems.com

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FOR YOUR SAFETY

Before undertaking any troubleshooting, maintenance or exploratory procedure, read carefully the **WARNINGS** and **CAUTION** notices.

This equipment contains voltage hazardous to human life and safety, and is capable of inflicting personal injury.

If this instrument is to be powered from the AC line (mains) through an autotransformer, ensure the common connector is connected to the neutral (earth pole) of the power supply.

Before operating the unit, ensure the conductor (green wire) is connected to the ground (earth) conductor of the power outlet. Do not use a two-conductor extension cord or a three-prong/two-prong adapter. This will defeat the protective feature of the third conductor in the power cord.

CAUTION
SENSITIVE ELECTRONIC DEVICES
DO NOT SHIP OR STORE NEAR STRONG ELECTROSTATIC, ELECTROMAGNETIC, MAGNETIC OR RADIOACTIVE FIELDS

Maintenance and calibration procedures sometimes call for operation of the unit with power applied and protective covers removed. Read the procedures and heed warnings to avoid “live” circuit points.

Before operating this instrument:

1. Ensure the proper fuse is in place for the power source to operate.

2. Ensure all other devices connected to or in proximity to this instrument are properly grounded or connected to the protective third-wire earth ground.

If the instrument:

- fails to operate satisfactorily
- shows visible damage
- has been stored under unfavorable conditions
- has sustained stress

Do not operate until performance is checked by qualified personnel.

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DOCUMENT CHANGE HISTORY

Revision	Date	Description of Change
A	03/31/2011	Document Control release
B	01/28/2012	Revised per ECN02268 updating bandwidth numbers in Chapter 3.

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Chapter 1
Introduction

The 530B Tracking Filter (**Figure 1-1)** accepts a complex signal at its input and provides a clean filtered signal at its output at frequencies between 5 Hz and 10,000 Hz. It automatically tracks a reference input signal and tunes the center of the filter to that frequency. The reference signal wave form can vary from a sine wave to a short duration pulse. Filter bandwidth can be adjusted manually or automatically via a front panel switch.

When in the MANUAL position, a thumb switch allows the filter bandwidth to be set from 001 Hz to 299 Hz. This bandwidth will remain constant over the entire frequency range. When switched to Auto (limit), the filter will automatically maintain a bandwidth, which is 10% of the Reference INPUT frequency until limited by the value set on the BW HZ thumb switch. For example, if the setting is 50 Hz, the filter BW will stay at 10% of the reference frequency until it reaches 500 Hz, where the bandwidth would be 50 Hz. Thereafter, as the reference frequency increases, the filter bandwidth would remain at its limit of 50 Hz.

A front panel digital meter allows monitoring NB-PH-WB signal levels. It is in true RMS units, and has two full-scale settings of 1 or 10 VRMS. The PH (PHASE) is degrees. There are two front panel LED's, ERROR and OVERLOAD. The ERROR LED illuminates when a wrong reference signal is applied. The OVERLOAD LED illuminates if the wideband input or filtered output is exceeded.

In addition to the filtered output, the 530B also provides rear panel outputs for linear and log DC of frequency as well as linear DC of level. A rear panel terminal strip provides TTL signals for overload and lock conditions as well as a means to remotely switch the full-scale range between 1 or 10 Volts.

Features include:

- Bandwidths from 1 Hz to 299 Hz
- Fixed or Variable Bandwidths
- 5 to 10,000Hz Frequency Range
- True RMS Meter (NB-PH-WB)
- Linear and Log DC of Frequency
- Linear DC of Level (or log) (Both Narrow and Wide Band)
- 115 or 230 VRMS Power

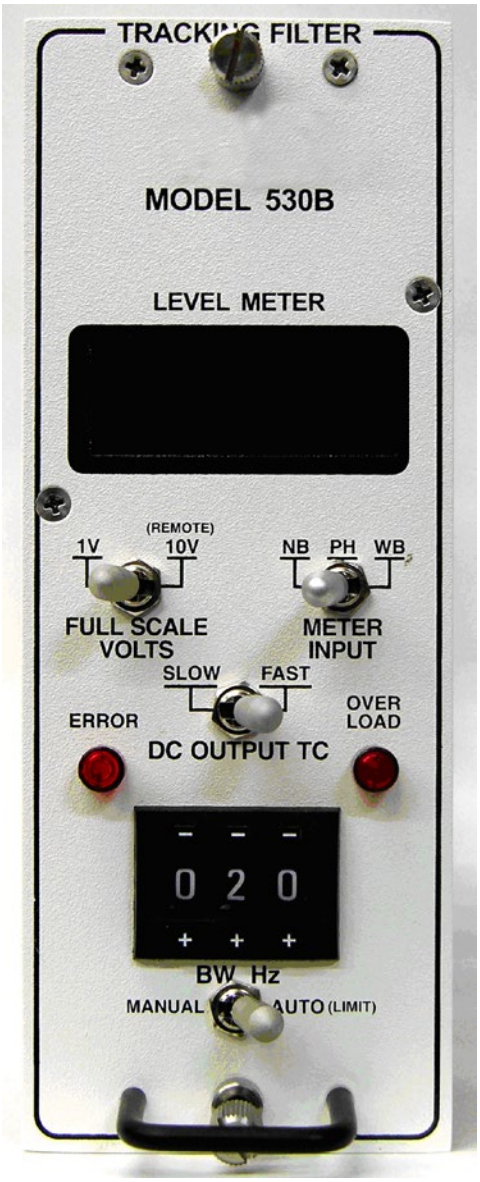

Figure 1-1, 530B Tracking Filter

System Description

General

The 530B Tracking Filter has two major parts. The Carrier Generator provides tuning to the analyzer portion and generates a linear and logarithmic DC voltage proportional to frequency.

The Analyzer part accomplishes the filtering and provides an AC Filtered output and both linear and logarithmic DC voltages proportional to the level.

Carrier Generator

The Carrier Generator uses a phase-lock-loop to track the reference input signal frequency. The reference frequency is multiplied by 256 and a binary divider residing in the W15B module counts it down to X1. The output from the divider is used to address two read-only memories, each programmed with a sine wave, one 90º phase shifted from the other. The SIN and COS outputs of the memories are used to tune the Analyzer. A digital counter output to analog converter provides a linear DC output. The log of frequency is accomplished in the DSP chip and brought out via a separate Digital to Analog Converter.

Analyzer

The Data Input first goes to a selectable gain circuit which sets the gain for either 1 Volt or 10 V RMS full scale as selected by the RANGE switch. The scaled signal goes to the 0º and 90º MDAC (in the W15) where the signal is mixed with the carrier signals and translated to a DC IF (Intermediate Frequency).

The DC plus side band signal is filtered by the variable Low Pass filter, and then is again translated to the original tuned frequency. This regenerated signal is at the output of the summing circuit. The level is scaled and brought out at the FILTERED output jack. The WB RMS level of the input is converted to DC by a TRMS converter, and a second for the narrow bandwidth (NB) TRMS converter.

The METER INPUT switch selects either the NB, PH (phase) or WB LEVEL to the meter input. The log of the WB and NB levels are derived and either can be brought out on the WB and NB Level output jacks instead of the linear outputs selected by an internal switch (S3) for the WB or S4 for the NB outputs. PH or WB outputs are selected to the WB LEVEL output jack by (S2).

System Specifications

Reference Input

Impedance	500 k Ohms
Frequency Response	5 Hz to 10,000 Hz
Level	50 mV Pk-Pk to 100 V Pk-Pk
Waveform	Sine, Triangle, Square or Pulse (pulse width 25 µs minimum).
Connector	BNC (isolated)

Data Input

Impedance	500 k Ohms
Frequency	5 Hz to 10,000 Hz
Level	1 or 10 VRMS full scale (FS)
Connector	BNC (Low side at signal ground)

Filtered Signal Output

Impedance	<50 Ohms
Frequency	5 Hz to 10,000 Hz
Level	0 to 10 Volts RMS
Distortion	5 to 10,000 Hz, <5% 20 to 5,000 Hz, <2%
Accuracy	±3% of Reading, ±0.5% FS
Dynamic Range	50dB
Connector	BNC (Low side at signal ground)

DC of Level (Linear)

Impedance	<50 Ohms
Maximum Out WBW	10 Volts FS
Maximum Out NBW	10 Volts FS
Accuracy	±3% of Reading, ±0.5% FS
Dynamic Range	60dB
Connector	BNC (Low side at signal ground)

DC of Frequency (Linear)

Impedance	<50 Ohms
Maximum Output	10 Volts (10,000 Hz)
Sensitivity	0.5 mV/Hz
Accuracy	±1% of Reading, ±0.1% FS
Connector	BNC (Low side at signal ground)

DC of Level (Log) Optional

Impedance	<50 Ohms
Maximum Output	10 Volts = 0dB
Sensitivity	125 mV/dB
Dynamic Range	50dB
WBW/NBW	(Optional)
Noise	50dB
Connector	BNC (Low side at signal ground)

DC of Frequency (Log)

Impedance	<50 Ohms
Maximum Output	10 Volts
Conformity	0.5 dB
Sensitivity	125 mV/dB
Connector	BNC (Low side at signal ground)

Bandwidth

Accuracy of Dial	±3%
Filter Shape	5-Section Bessell

Time Constant

	Fast	Slow
Narrow Bandwidth	0.3 sec	1 sec.
Wide Bandwidth	0.3 sec.	1 sec.

Controls

Range FS Volts Switch	Selects 1 V or 10 V FS Input Range.
Meter Input Switch	Selects WB, NB amplitude, or PH (phase).
DC Output TC Switch	Selects SLOW or FAST time constant for meter (and DC outputs).
Manual Auto (Limit) Switch	Selects Auto BW or Manual BW. In Auto (Limit) mode, Bandwidth is 10% of the REF frequency. In the MANUAL mode, a fixed bandwidth is selected via the front panel BW Hz thumb switch.
Filter IN-OUT Switch	Located on the front panel of the chassis, allows the signal to pass through the tracking filter in the Filter position and to bypass the tracking filter in the Bypass position.

Indicators

Level Meter	3-1/2 Digit meter indicating level in Volts RMS or Degrees.
OVERLOAD LED	LED illuminates if input to tracking filter is too high for selected range, or if output from filter to meter is too high.
ERROR LED	LED illuminates when an in-correct signal is applied to the REF Input.

Power

	115 or 230 Volts, 50-400 Hz.

Size

	7” High x 2.7” Wide x 13” Deep.

Cabinets (required)

Single-Module	4220
Six-Module 19” Rack	4200
Optional	Plug-in HP and LP Filter Assy 1697-1 is available with 3-selectable High Pass and 3-selectable Low Pass Filters. Frequency cutoffs are: HP-5, 30 or 70 Hz, LP-5000, 10,000 or 20,000Hz.

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Chapter 2
Operation

The 530B Tracking Filter is designed to require little operator attention. The front panel has a METER INPUT switch, RANGE FS VOLTS switch, DC OUTPUT TC switch, MANUAL-AUTO (Limit) switch (in conjunction with a BW HZ thumb switch), an OVER LOAD LED, an ERROR LED, and a 3-1/2 Digit DVM display. A description of each follows.

Meter Input Switch

The Meter INPUT Switch is a three-position toggle switch to select either the NB (narrow bandwidth) or WB (wide bandwidth) TRMS DC output or the PH (phase) DEG (degrees). The bandwidth of the NB input is determined by the BW HZ thumb switch 001 to 299 in 1 Hz steps. The WB input has a HP-LP Filter Assembly option with settings available to filter the WB output. See WIDE BANDWIDTH FILTER at the end of this section. The PH DEG selects the DC of Phase shift between the REF and DATA signal to the meter.

Range FS Volts Switch

The RANGE FS VOLTS Switch is a two-position toggle switch to select either 1 or 10 VRMS FS at the DATA INPUT jack, and at the FS meter range. The 1 or 10 VRMS FS range can be selected remotely by a ground on the terminal labeled “RANGE”; when the remote selection is used, the RANGE switch must be in the 10V (REMOTE) position.

DC Output TC Switch

The DC OUTPUT TC Switch is a two-position toggle switch to select either a SLOW or FAST time constant for the NB and WB DC outputs and meter response. The DC OUTPUT TC switch changes the time constant of both NB and WB TRMS detectors simultaneously.

MANUAL-AUTO (LIMIT) Switch and BW Hz Thumb Switch

This two-position toggle switch below the BW Hz thumb switch selects either MANUAL or AUTO (Limit). When the MANUAL position is selected, the BW Hz thumb switch sets the filter bandwidth in 1 Hz steps to 299 Hz. When the AUTO (Limit) is selected, the filter bandwidth is one-tenth the reference tuning frequency. The bandwidth is 1 Hz with a reference frequency from 10 Hz and at 20 Hz; the bandwidth of the filter is 2 Hz and as the reference frequency changes, will maintain 10% of the reference frequency until it reaches the number of the BW Hz thumb switch limit setting.

OVER LOAD Light

This indicator is a red LED labeled OVER LOAD. The OVER LOAD LED illuminates when either the input or meter circuit is overloaded. When on, the purpose of the LED is to alert the operator that an overload condition exists and the acquired data may not be valid.

ERROR Light

This indicator is a red LED labeled ERROR. The ERROR LED illuminates when an incorrect signal is at the REF Input. Correct REF Input signal are (levels of 50 mV–100 VRMS) with any reoccurring wave form (sine, square or triangle).

DVM Front Panel Meter

The front panel DVM (digital voltmeter) is calibrated to indicate the DATA Input level in TRMS units for the NB and WB settings and in degrees for the PH (Phase).

Wide Bandwidth Filter *(Optional)*

A plug-in HP-LP Filter Assembly, part number 1697-1, is available to filter the wide bandwidth detector input.

The filter assembly plugs into the A4 header on the main board and screws down to two studs. The jumper between Pin 3 and Pin 6 of A4 must be removed before installation. The filter assembly provides three switch-selectable low-pass filter bandwidths of 5, 10 or 20 kHz, and three switch-selectable high-pass filter bandwidths of 5, 30 and 70 Hz. The low-pass and high-pass filters are each four-section Butterworth designs. Other filter bandwidths can be furnished on special order.

Chapter 3
Performance Test

The following procedure outlines a method of testing the 530B Tracking Filter. The unit may be in a single-unit cabinet or the one that holds six (6) units. The following procedure is for a single unit, and must be repeated for each module. In the event that a reading is out of tolerance, the unit will require calibration. (See Chapter 4.)

Test Equipment

Note: Equivalent equipment can be substituted.

Multimeter	Fluke 4588A
Generators (2)	Trig-Tek 45EMD Portable Calibrator.

Switch Setttings

Place the FS RANGE switch to 10 V, the MANUAL-AUTO switch to MANUAL, the BW HZ thumb switch to 005, and the DC OUTPUT TC switch to SLOW. Connect the power cord of the rack assembly into the power line and turn the POWER switch at the left side of the rack to ON.

Performance Test Procedure

1. Connect the generator to the REF INPUT jack.
2. Set the generator for a frequency of 10,000 ±5 Hz and a level of approximately 1 VRMS.
3. Connect the DC voltmeter to the LIN DC of FREQ OUTPUT jack.
4. Observe a 10 ±0.10 Volt indication on the DC voltmeter. (The ERROR LED should not be illuminated).
5. Set the generator for a frequency of 10 ±0.1 Hz.
6. Observe a 10 ±4 mV indication on the DC voltmeter.
7. Connect the DC voltmeter to the LOG DC of FREQ jack.
8. Set the generator for a frequency of 10,000 ±20 Hz.
9. Observe an indication of 10.00 ±0.50 V on the DC voltmeter.
10. Set the generator for a frequency of 100 ±0.1Hz.

11. Observe an indication of 5.00 ±0.50 V on the DC voltmeter.
12. Connect the generator to both the REF input and DATA input.
13. Set the generator for a frequency of approximately 500 Hz at a level of 10.00 ±0.03 VRMS.
14. Connect the DC voltmeter to the NB Output jack.
15. Place the METER INPUT switch to NB.
16. Observe a 10.00 ±0.25 V indication on the DC voltmeter.
17. Observe that the front panel meter indicates 10.00 ±0.25 VRMS.
18. Place the METER INPUT switch to WB.
19. Connect the DC Voltmeter to the WBDC OUTPUT jack.
20. Observe an indication of 10.00 ±0.25 V on the DC voltmeter.
21. Observe that the front panel meter indicates 10.00 ±0.25.
22. Connect the AC Voltmeter to the FILTER OUTPUT jack.
23. Observe a 10.00 ±0.5 VRMS indication on the AC voltmeter.
24. Set the generator level for 1 ±0.005 VRMS.
25. Connect the DC voltmeter to the NB OUTPUT jack and the RANGE Switch to 1 VRMS.
26. Place the METER INPUT switch to NB.
27. Observe a 10.00 ±0.25 Volt indication on the DC Voltmeter. The front panel meter should indicate 1.00 ±0.03.
28. Connect the AC Voltmeter to the FILTER output jack.
29. Observe an indication of 1.00 ±0.05 VRMS on the AC voltmeter.
30. Set the generator frequency for 5 Hz.
31. Observe an indication of 1.000 ±0.05 on the front panel meter.
32. Set the generator frequency for 10,000Hz.
33. Observe an indication of 1 ±0.05 VRMS on the AC voltmeter. The front panel meter should indicate 1.000 ±0.05.

Checking the Bandwidth

Two generators are needed for performing the following test:

1. Connect generator #1 to the REF INPUT jack.
2. Set the generator #1 for approximately 1 VRMS level and for a frequency of 500Hz.
3. Connect generator #2 to the DATA INPUT jack.
4. Set the FS Range switch to 1 V, the METER INPUT switch in NB, the MANUAL-AUTO switch to MANUAL and the BW Hz thumb switch to 002.
5. Set the frequency of generator #2 to 500 ±0.1 Hz and the level to 1.000 ±0.005 VRMS.
6. The front panel meter should indicate 1.00 ±.03 VRMS.
7. Set generator #2 for 501 Hz.
8. Observe 0.707 ±0.1 VRMS indication on the front panel DPM. (Note that the front panel DPM indication may vary at 1 Hz rate around the 0.707 ±0.1 VRMS).
9. Set generator #2 for 525 ±0.1 Hz.
10. Set BW HZ thumb switch to 050.
11. Observe a .0.707 ±0.1 VRMS indication on the front panel meter.
12. Place the BW Hz thumb switch to 010.
13. Connect generator #1 SQ WAVE OUTPUT to the REF Input, and the DATA Input. Set at 100 ±0.1 Hz.
14. Place METER INPUT Switch to PH (Phase).
15. Observe an indication of 0 ±5 degrees on the front panel meter.

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Chapter 4
Calibration Procedure

The 530B Tracking Filter module adjustments are all accessible when the unit is removed from the chassis. Use a power cord assembly TT-1535 and a 530B board test assembly TT-1789 to accommodate bench testing the unit. Contact Sales or Customer Support for information about these accessories. The following procedure provides a means of setting each adjustment.

Refer to **Figure 4-1** for locations of various potentiometers and switches on the internal circuit board. Note that some adjustments call out the pots on the attached W15 board. Even though they may have the same resistor number, be sure to adjust the correct resistor.

Test Equipment

Note: Equivalent equipment can be substituted.

Multimeter	Fluke 4588A
Generators (2)	Trig-Tek Portable Calibrator.
Oscilloscope	
Power Cord Assembly	Trig-Tek TT-1535.
Board Test Assembly	Trig-Tek TT-1789.

WARNING

Damage can occur to the circuitry if the internal switch, S1, is set to the 115 position and 230 VRMS AC power is applied. See Figure 4-1 for the location of S1.

Test Procedure

1. Remove the 530B module to be tested from the cabinet.
2. Use the power cord assembly (TT-1535) to connect power to the module.
3. The inputs and outputs on the pins of the P1 connector are brought out on BNC Connectors of the test assembly (TT-1789).
4. When the assembly is plugged onto P1, set the following on the front panel:
    a. OUTPUT TC switch to FAST

b. FS RANGE switch to 10 VRMS
c. METER INPUT switch to NB
d. MANUAL-AUTO (Limit) switch to MANUAL
e. BW HZ thumb Switch to 010.

5. Ensure the following is set on the 530B main circuit board:
   a. S2 to WB
   b. S3 to LIN
   c. S4 to LIN
   d. S5 to OFF
   e. S6 to SE

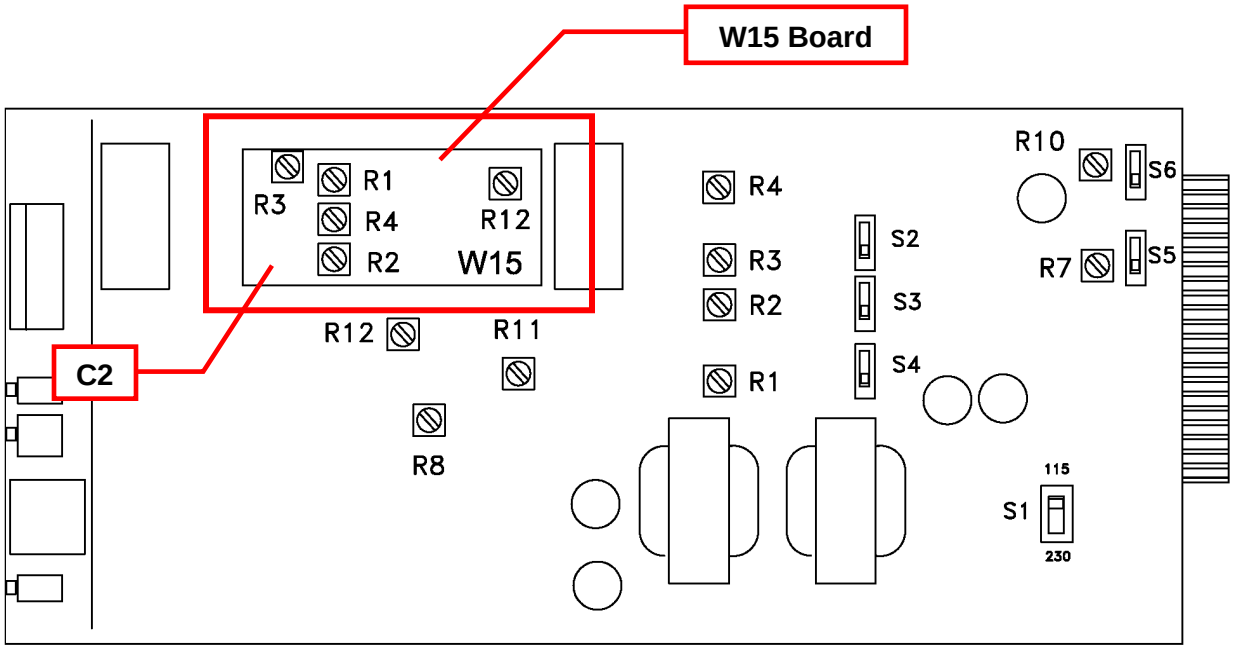

Figure 4-1, Adjustment Resistor Locations

DC of Frequency Adjustments (Linear)

1. Connect the generator to the REF INPUT jack, Pins 17 and 18 of P1.
2. Set the generator for a frequency of 10.000 ±10Hz and set for a level of approximately 1 V.
3. Connect the DC voltmeter to the LIN DC of FREQ OUTPUT jack, Pin 8 of P1.
4. Set R1 (TACH FS ADJ) for 10.00 ±.05 V indication on the DC voltmeter.
5. Set the function generator for a frequency of 10 ±10 Hz.

6. Observe 10 ±2 mV indication on the DC voltmeter.
7. Set the function generator for frequency of 10.000 ±10 Hz.
8. Check the LIN DC of FREQ for 10.00 ±.05 V, connect the DC voltmeter to the LOG DC of FREQ jack at Pin 15 of P1.
9. Set R2 (FS ADJ) for 10.00 ±.01 V indication on the DC voltmeter.

DC Zero Adjustments (W15B)

1. Connect the generator to the REFERENCE INPUT, Pin 17 and 18 of P1.
2. Set the generator for a frequency near 500 Hz and a level of approximately 1 V.
3. Short the DATA INPUT, Pins 13 and 16 of P1.
4. Connect the DC voltmeter to test point C2 (**on the W15 board**).
5. Set R1 (DC ADJ) for a 0 ±3 mV indication on the DC voltmeter.
6. Connect the DC voltmeter to test point S2.
7. Set R2 (DC ADJ) for a 0 ±3 mV indication on the DC voltmeter.

FS Range Adjust

1. Connect the generator to both of the REF and DATA INPUT jacks, Pins 17 and 18, and Pins 13 and 16 of P1.
2. Place the RANGE switch to 10 V.
3. Set the generator for a frequency of 500 Hz and a level of 10.00 ±.01 V.
4. Place the METER INPUT switch to NB.
5. Connect the DC voltmeter to the NB OUTPUT jack, Pin 10 of P1.
6. Set R12 (NB FS ADJ) for a 10.00 ±0.02 V indication on the DC voltmeter.
7. Set the R1 (METER REF ADJ) on the front panel meter board (**Figure 4-2**) for an indication of 10.00 ±0.02 on the front panel meter.
8. Place the METER INPUT switch to WB. Connect the DC voltmeter to WB OUTPUT, Pin 14 of P1.
9. Set R8 (WB FS ADJ) for a 10.00 ±.03 V indication on the DC voltmeter. (The front panel DVM will indicate 10.00 ±0.10 VRMS).
10. Connect the AC voltmeter to the FILTER OUTPUT jack, Pins 11 and 9 of P1.
11. Set R4 (**on the W15 board**) for a 10.00 ±0.10 V indication on the AC voltmeter.

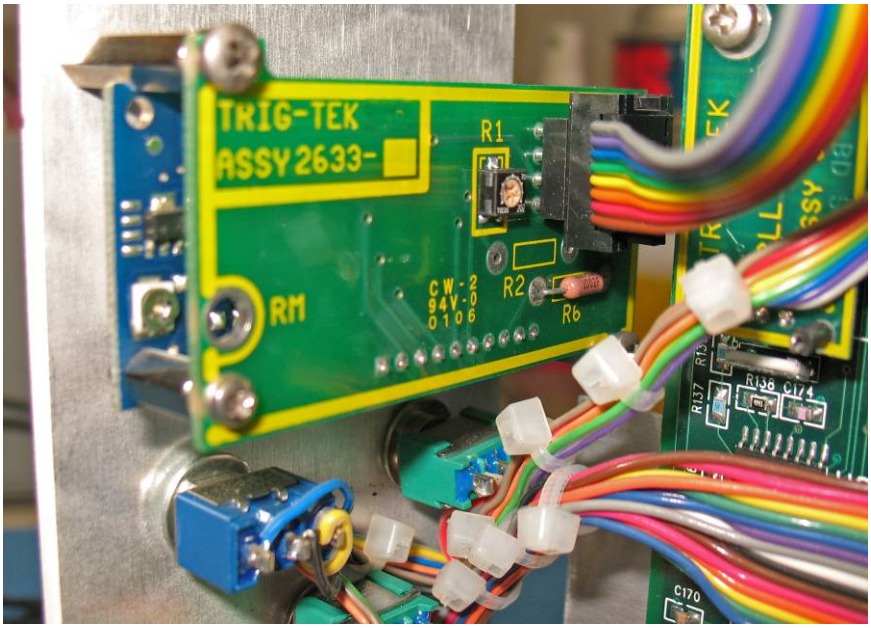

Figure 4-2, Front Panel Meter Circuit Board Adjustment

Log of Adjustments

1. Connect the DC voltmeter to the NB OUTPUT jack, pin 10 of P1.
2. Set internal switches S3 and S4 to LOG position, and S2 to WB.
3. Set the RANGE switch to 10V, and the generator for 10.00 ±.05 VRMS.
4. Set R3 (NB LOG ADJ) for a 10.00 ±0.1 V indication on the DC voltmeter.
5. Connect the DC voltmeter the WB OUTPUT jack, Pin 14 of P1.
6. Set R4 (WB LOG ADJ) for a 10.00 ±0.10 V indication on the DC voltmeter.

Note: High pass, low pass filter part number 1697-1 is not a Butterworth filter. The spread between the –5% and –3dB points is not calculated in the usual way. Test to the following 3dB points ±10%.

HP	LP
3.4 Hz	3.5 KHz
19.8 Hz	7 KHz
43 Hz	14.1 KHz

Bandwidth Adjustments (W 15B)

1. Connect generator #1 to the REF INPUT jack. Verify that the TC switch is in SLOW.
2. Set the generator #1 for approximately 1 VRMS level and for a frequency of 1000 ±0.1 Hz.
3. Connect generator #2 to the DATA INPUT jack.
4. Set the FS RANGE switch to 1 V RMS, the METER INPUT switch to NB, the BANDWIDTH switch to MANUAL, and set the BW HZ thumb switch to 200.
5. Set the frequency of generator #2 to 1000 ±0.1 Hz and the level to for a 1.000 ±.01 volt indication on the LEVEL METER.
6. Set generator #2 for 1100 ±0.1 Hz.
7. Set R3 (**on the W15 board**) for a .707 ±.050 VRMS indication on the front panel LEVEL METER.
8. Set the generator #2 for 1001 ±0.1 Hz.
9. Set the BW HZ thumb switch to 002.
10. Look for a 0.707 ±.050 VRMS indication on the front panel meter.

(Note that it is normal for the indication to vary upwards and downwards around this central value at a 1 Hz rate).

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